Reference from written Opinion (8-10-00)

D2

(19) Patent office of Japan (JP) (11) Publication of Patent Application

(12) **JAPANESE PATENT APPLICATION (KOKAI) (A)**

Showa 56-10312

(51) Int. CL.5	ID Code	Office Cont'l Nbr.	(43) Publication: Showa 56 (1981) 2/2
B 01 D 39/14		6939-4D	
B 01 D 35/06		7148-4D	
46/12		7717-4D	

Verification Request: not requested

Number of claims of the invention: 1

Number of pages (total of 4)

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(54) Name of the invention: Electret Filter

(21) Filed Number: Showa 54-87343

(22) Filed date: Showa 54 (1979) 7/9

Patent Assignees:

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JP 56-10312

[Note : Names, addresses, Company names and brand names are translated in the most common manner. Japanese Language does not have singular or plural words unless otherwise specified with numeral prefix or general form of plurality suffix. Translator's note.]

Description of the invention

1. Name of the invention

Electret Filter

2. Range of the claims of the invention

Electret filter, that has as its main material a material where, an electretized macromolecular (polymeric) film is continuously bent or folded, and over the whole surface of the film wrinkles are formed and a thickness is acquired and together with that a large number of connected air paths are formed.

2. Electret filter according to the above described Claim 1 of the present invention, where a laminated layer product that is obtained as the electretized film with the formed on it wrinkles is horizontally stacked and the front edges of the wrinkles are adhered or melt adhered onto the film surface, is used as the main material.

3. Detailed explanation of the invention

The present invention is an invention about an electret filter, that is used in order to remove the fine (microscopic) particles, that are mixed in a gas material or a liquid material, with the goal to purify the air, dust collection, etc.

As an equipment that is used in order to purify air by eliminating the tobacco smoke or dust etc., from the air, already, the equipment where dust is electrically eliminated, and the electrostatic filter, etc., have been used. However, in the case of these devices, the equipment costs are high, and not only that, but also, there are the drawbacks that it is said that the working life, where an effective flowing capability is maintained, is short.

Regarding the present invention, it is an invention where in order to eliminate these drawbacks an electret filter is suggested where an electretized macromolecular film is used as the filter, that has excellent dust collection capability and also that has

a long working life.

Regarding the present invention, it is an invention about an electret filter, that has as its main material a horizontal layer product where, an electretized macromolecular film is continuously bent or folded, and over the whole surface of the film wrinkles are formed and a thickness is acquired and together with that a large number of connected air paths are formed, and by using this electretized film the structure of the electret filter is formed. Also, in the case of the present invention, the front edges of the wrinkled electret film, that has been stacked, are adhered or melt adhered, and this laminated layer product is used as the main material of the electret filter.

Regarding the macromolecular material that is used according to the present invention, it is a good option if it is a material that can form a film according to the melt molding method, the flow- extension method, the cutting method etc., and for example, it is possible to use polyolefin resin, polyester resin, polyamide resin etc., thermoplastic resins, phenol resin, formaldehyde resin, urea - formaldehyde resin, melamine - formaldehyde resin, etc., thermo setting resins. Among these resin materials, besides the polyethylene, polypropylene, poly - 4- methyl - 1- pentene, polystyrene, etc., polyolefin resins, that have excellent electret performance, also, polyethylene terephthalate, etc., polyester resins and polycarbonate resin, are preferred. And these resins include the materials that are compounded with or graft polymerized with unsaturated carboxylic acids or their derivative materials. Also, in these resin materials, depending on the requirements, it is also possible to compound the well known from the previous technology, stabilization agents, for example, anti-oxidation agents, thermal resistance stabilization agents.

Regarding the macromolecular film material, usually, it is produced at a thickness that is within the range of approximately 3 microns ~ 3 mm, and depending on the requirements, it is uniaxially or biaxially oriented. In the case of this macromolecular film material, it is also a good option if it is a foamed material or a material that has porous properties, and it is also a good option if it is a material that has been subjected to a crosslinking treatment, and it is also a good option if it is a nonwoven fabric type film, and it is also possible to use a material where 2 or more layers have been layer laminated. The macromolecular film material is electretized according to the different well known methods, like for example, the thermal electretization method, the electro-electretization method, the radio- electretization method, the mechano - electretization method, the magneto - electretization method, the hot electretization method, etc. In the case of this electretization treatment, depending on the goal, it can be conducted at the same time with the film formation, or before or after that.

After that, the practical examples according to the present invention will be explained based on the diagrams presented.

In the case of the Practical Example 1, that is shown in Figure 1, the electretized film 1 is continuously bent in a mountain type shape, and over the whole surface of the film, the wrinkles 2, are formed, and a thickness is obtained, and together with that, a large number of triangular prism shape continuous air paths 3, are formed, and this electretized film 1 that has the imparted on it wrinkles, is stacked in the direction of the thickness, as a flat electret film 4 is inserted in between, and also, on the bottom side also, a flat electret film is added, and the front edges of the wrinkles are adhered or melt adhered onto the flat electret film 4, and the product 5 of laminated layers of electret film that has imparted on it wrinkles, is obtained.

According to this practical example, it is preferred that the distance between the same wrinkled electret film 1, 1, 1 in the layer lamination direction, is made to be the same, namely, it is desirable that each film is placed in a position that is parallely translated relatively to the direction of the layer lamination.

In the case of the Practical Examples 2 that is shown in Figure 2, an electret film 6 is folded so that a continuous pile is formed, and over the whole surface of the film, the wrinkles 7 are formed, and a thickness is obtained, and together with that, a large number of deformed cylinder air pathways 8, is formed, and then this electret film 6, with the imparted on it wrinkles, is stacked in the direction of the thickness, as a flat electret film 9 is inserted in between, and also, on the bottom side also, a flat electret film 9 is added, and the front edges of the wrinkles are adhered or melt adhered onto the flat electret film 4, and the product 10 of laminated layers of electret film that has imparted on it wrinkles, is obtained.

Regarding the Practical Example 3, that is shown according to the presented in Figure 3, the electret film 11 is continuously folded along the longitudinal direction, and over the whole surface of the film the wrinkles 12 are formed, and thickness is acquired, and together with that, a large number of square cylinder shaped continuous air pathways 13, are formed, and this wrinkled electret film 11 is stacked in the direction of the thickness, and the front edges 14 of the wrinkles are adhered or melt adhered, and the structure of the wrinkled electret film laminated layer product 15, is formed.

In the case of the Practical Example 4, that is shown according to the Figure 4, the electret film 16 is continuously bent in a pile type shape, and over the whole surface of the film, the small wrinkles 17 are formed, and thickness is acquired and together with that the square cylinder shaped continuous air pathways 18, are formed, and the front edges 19 of the the wrinkled electret film 16, that is laminated at the bottom, are adhered or melt adhered onto the surface of the film, and by that the structure of the wrinkled electret film laminated layer product 20, is formed.

Regarding these practical examples, the film layers are fixed to each other by adhesion or melt adhesion, and usually, the film layers are stacked over each other and then from both sides they are fixed by pressure, and by that the structure of the

filter is obtained.

Figure 5 is a figure in order to show one detailed example of the filter, and in that case, in the box 21, that has been cut open on both the front and the back surface, the laminated layer product 5, that is formed from the imparted with wrinkles electret filter, is inserted, and the air that is being purified 21, is flowing in the direction from the front to the back surface of the box 11, and it passes through the continuous air pathways 3.....

Regarding the present invention, as it has been shown according to the Practical Examples 1 ~ 4, it is an invention that has as the main materials of the filter, the laminated layer product 5, 10, 15 and 20, that are formed as the electretized film is continuously bent or folded and over the whole surface of the film, the wrinkles 2, 7, 12 and 17, are formed, and this imparted with wrinkles electret film 1, 6, 11, 16 is correspondingly stacked in the direction of the thickness, and the front edges of the wrinkles are adhered or melt adhered onto the film surface, and then, the air that is being purified is flowing in the direction of the wrinkles and it passes through the continuous pathways 3, 8, 12 and 18.

According to the present invention, the contact surface area of the air and the electret film, is increased, and because of that, the dust collection efficiency is increased, and because the air is flowing easily, there is little loss of pressure, and also, because in the case of the the imparted with wrinkles electret film, the front edges of the wrinkles are adhered or melt adhered, there is no deviation from the shape, and during the use, there is no fluttering, and due to that, there is no volatilization of the adhered dust material, and because of the cooperation of all of these factors, a filter is obtained that has excellent dust collection performance and also, that has a long working life.

When the filter according to the present invention is compared according to the nonwoven fabric type filters (A), (B), (C), according to the previous technology, and the filter (D), that has a structure that is formed by the layer lamination of flat electret film, the results obtained are according to the presented in Table 1.

Table 1

	Pressure Loss (20 cm/g)	Efficiency (0.3 u, %) Initial	After time (after 336 h)

Present invention	0	56.0	55.7
Previous products			
(A)	2.5	11.0	18.0
(B)	12.0	51.0	13.2
(C)	18.0	83.0	91.5
(D)	0	45.0	24.0

As it becomes clear from the presented in this Table 1, in the case of the present invention, the pressure loss is 0, and not only that, but also, it has a high efficiency. And contrary to that, in the case of the filter (A), among the filters according to the previous technology, the pressure losses are relatively low, however, the efficiency is poor. And in the case of (B) and (C), the efficiency is good, however, the pressure losses are high. Also, in the case of the flat electret film laminated layer product (D), the pressure losses are 0, and the efficiency is relatively good, however, with the passing of the time the efficiency is quickly decreased.

In the case according to the present invention, because at the time of use there is no fluttering, there is no volatilization of the adhered dust material, and the pressure losses are extremely small, and because of that, there are many effects, such that it is possible to reduce the energy, and also, because the contact surface area is wide, the dust collection efficiency is high, and both the initial efficiency and the efficiency after the passing of the time, are excellent, etc.

4. Simple explanation of the figures

Figure 1 ~Figure 4 are correspondingly front surface diagrams showing the Practical Examples 1 ~ 4 according to the present invention. And Figure 5 is a three-dimensional diagram that shows a detailed example of the filter.

Moreover, 1, 6, 11 and 16 represent the wrinkled electret film, 2, 7, 12, 17 represent the wrinkles, 3 , 8, 13, 18 represent the continuous air pathways, and 14 and 19 represent the continuous air pathways.

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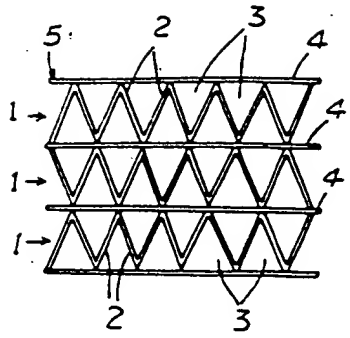
Translated by Albena Blagev (735-1461 (h), 704-7946 (w))

10/14/98



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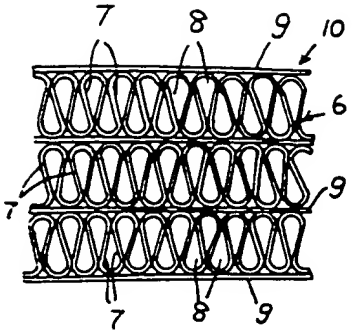

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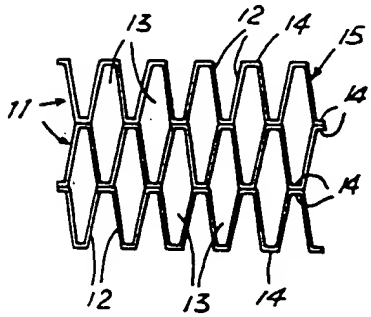

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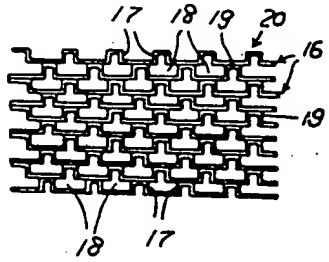

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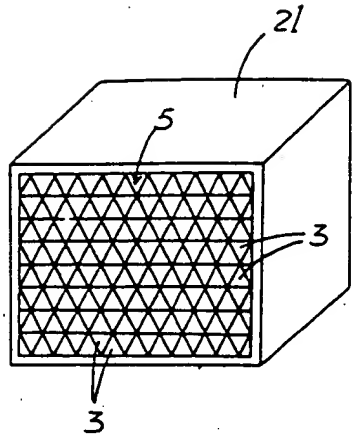

第5図